

5. Which of the following classes of enzymes digests carbohydrates? (1)

A. ✓ **Amylases**

B. Lipases

C. Proteases

D. Nucleases

Answer: A

Amylases are the carbohydrate digesting enzymes. The name comes from amylum, the Latin word for starch, and salivary and pancreatic amylase both break starch down into maltose and then to glucose. Enzymes are usually named after what they act on, which is the quickest way to sort this list. Proteases are tempting only if the naming rule is missed: they act on proteins, not on sugars.

6. Which of the following kingdoms of life is consisting of prokaryotic organisms? (1)

A. Fungi

B. ✓ **Monera**

C. Protista

D. Plantae

Answer: B

Monera is the kingdom of bacteria and related organisms, and these are prokaryotes: their DNA lies free in the cytoplasm with no nuclear membrane around it, and they have no mitochondria or other membrane bound organelles. Protista is the tempting answer because many protists are single celled and look simple, but a single celled amoeba or paramecium still has a true nucleus and organelles, which makes it a eukaryote.

7. Which component of soil fertility is improved when farmers grow legumes in crop rotation ? (1)

A. Phosphorus

B. ✓ **Nitrogen**

C. Sulfur

D. Carbon

Answer: B

Legumes such as beans, peas and faba beans carry root nodules containing Rhizobium bacteria. These bacteria take nitrogen gas from the air in the soil and change it into ammonia, which the plant and later the soil can use, so the field is left richer in nitrogen than the crop found it. Phosphorus is tempting because it is the other nutrient farmers most often add, but no crop can pull phosphorus out of the air: it has to come from the rock and the soil itself.

8. Which one of the following do bees use to inform other bees about location and distance of a new source of nectar they discover? (1)

A. Pheromones

B. ✓ **Waggle dance**

C. Buzzing noise

D. vibration of wings

Answer: B

A returning honey bee performs a waggle dance on the vertical comb. The angle of the straight waggle run away from vertical gives the direction of the food relative to the sun, and the length of the waggle run gives the distance, so one dance carries both pieces of information. Pheromones are tempting because bees do use them heavily, for alarm signals and for the queen, but a chemical spreading through the hive cannot tell a bee which way to fly or how far.

9. What are the specialists in biology called if he/she studies fossils to generate new knowledge on the origin and evolution of living things of past geologic periods? (1)

A. Geneticist

B. Ecologist

C. ✓ **Paleontologist**

D. comparative Biochemist

Answer: C

A paleontologist studies fossils: the remains and traces of organisms preserved in rock. By dating the rock layers and comparing the fossils in them, a paleontologist reconstructs which forms of life lived in each geological period and how they changed. A comparative biochemist is tempting because that work is also about evolutionary relationships, but it compares proteins and DNA of organisms that are alive now, not remains preserved in rock.

10. All proteins contain carbon, hydrogen, oxygen and what other element?

(1)

- A. Chlorine
C. ✓ Nitrogen
B. Fluorine
D. Sulphur

Answer: C

Proteins are chains of amino acids, and every amino acid carries an amino group, written $-NH_2$. That group is where the nitrogen comes from, so no protein can exist without nitrogen. This is also why plants need nitrate from the soil to build protein. Sulphur is the tempting choice because it does appear in proteins, but only in two amino acids, cysteine and methionine, so a protein built without those has no sulphur at all.

11. Which of the following is the correct F_2 phenotypic ratio of a monohybrid cross?

(1)

- A. 1:2
C. ✓ 3:1

Answer: C

In a monohybrid cross the F_1 plants are all heterozygous, for example Aa . Crossing two of them gives AA , Aa , aA and aa in equal numbers. The first three all show the dominant character because each carries at least one A , and only aa shows the recessive one, so the phenotypes come out 3 : 1. The ratio 1 : 2 tempts students who are half remembering the genotypic ratio, which is 1 : 2 : 1 and counts genotypes rather than appearances.

12. How many carbon atoms are there in one disaccharide molecule?

(1)

- A. 6
C. 18
B. ✓ 12
D. 24

Answer: B

A disaccharide is two simple sugars joined together, and the sugars involved here are hexoses, meaning each has six carbon atoms. Joining them releases one molecule of water but loses no carbon, so $6 + 6 = 12$. Maltose, sucrose and lactose all follow this pattern with the formula $C_{12}H_{22}O_{11}$. The answer 6 tempts because that is the count for a single monosaccharide such as glucose.

13. Which unit is best to use for measuring the smallest cells and organelles?

(1)

- A. Micrometer
B. Milliliter
C. Millimeter
D. ✓ Nanometer

Answer: D

A nanometre is one thousandth of a micrometre, and the smallest structures inside a cell are measured on that scale. A ribosome is about 20 nm across and a membrane is about 7 nm thick, so nanometres give whole convenient numbers instead of tiny fractions. The micrometre is the tempting answer because it is the right unit for whole cells, where a red blood cell is about 7 micrometres wide, but it is far too coarse for the smallest organelles.

14. Which energy rich organic compound contains adenine in its molecule ?

(1)

- A. Lipid
B. Carbohydrate
C. Glucose
D. ✓ **ATP**

Answer: D

ATP stands for adenosine triphosphate. The molecule is built from the base adenine joined to the sugar ribose, with three phosphate groups attached, and the energy is released when the bond to the last phosphate is broken. Glucose is the tempting answer because it is the cell's main energy fuel, but glucose is made only of carbon, hydrogen and oxygen, so it contains no adenine and no nitrogen at all.

15. What are the most frequent causative agents of food poisoning?

(1)

- A. ✓ Bacteria
B. Protozoa
C. viruses
D. Worms

Answer: A

Most food poisoning is caused by bacteria such as Salmonella, Staphylococcus and some strains of E. coli. Warm food left standing lets them multiply quickly, and some of them also release toxins that make a person ill even after the food is heated. This is why cooking food through, keeping it covered and eating it fresh matter so much. Viruses are the tempting answer because they do cause food borne illness, but they cannot multiply in the food itself, so they cause fewer cases.

16. What are the most likely causes of variations within species?

(1)

- A.** Mitosis and a sexual reproduction.
- B.** Overpopulation and overproduction.
- C.** Vegetative propagation and cloning.
- D. ✓ Mutations and sexual reproduction.**

Answer: D

Variation within a species comes from two sources working together. Mutation changes the DNA and so creates alleles that never existed before, and sexual reproduction then shuffles those alleles into fresh combinations through crossing over, independent assortment and random fertilisation. Option A tempts because mitosis and asexual reproduction are real processes, but both copy the parent's DNA exactly, so they produce offspring that are alike rather than varied.

17. In which hominid species did scientists find the smallest brain size (cranial capacity)?

(1)

- A. Homo Sapiens
B. ✓ Homo Habilis
C. Homo erectus
D. Homo neanderthalensis

Answer: B

Homo habilis is the earliest member of the genus Homo in this list, with a cranial capacity of roughly 600 to 700 cubic centimetres. Homo erectus reaches about 900, Neanderthals about 1500 and modern Homo sapiens about 1350, so habilis has the smallest brain of the four. Homo erectus is the tempting answer because it is also an early species, but it comes later in time and its skull is noticeably larger.

18. Which of the following is NOT classified as a learned behavior?

(1)

- A. Insight** **B. ✓ Innate**
C. Latent **D. Conditioned**

Answer: B

Innate behaviour is present from birth and is coded in the animal's genes, so it appears without any practice or teaching. The other three all describe behaviour an animal picks up from experience, so innate is the one that does not belong. Conditioning is the tempting answer because it can look automatic once it is established, but the animal has to live through the repeated pairing of two stimuli before the response appears, which makes it learned.

19. In which one of the following aspects is the tropical rain forest biome poor?

(1)

- A. Species diversity
B. amount of sunlight
C. Annual precipitation
D. ✓ **Soil fertility**

Answer: D

Tropical rain forest soil is poor. The rain is heavy all year and washes minerals down out of the topsoil, and the nutrients that remain are locked up in the living trees rather than in the ground, because dead leaves rot and are taken up again within weeks. This is why cleared rain forest land gives only a few good harvests. Species diversity is the tempting answer, but the rain forest is the richest biome on earth in species, not the poorest.

20. If the size of a cell increase, which one of the following gets smaller? (1)
- A. The volume of the cell
 - B. The surface area of the cell
 - C. ✓ **surface area to volume ratio of cell**
 - D. volume to surface ratio of the cell

Answer: C

As a cell grows, its surface area increases with the square of its size while its volume increases with the cube. Take a cube of side 1 unit: the area is 6 and the volume is 1, giving a ratio of 6. Double the side to 2 units and the area is 24 while the volume is 8, so the ratio falls to 3. The surface therefore becomes small compared with the contents it has to feed, which is why cells stay small and divide. Option D tempts by reading the same fraction upside down: the volume to surface ratio gets larger, not smaller.

21. What makes unsaturated fatty acids different from saturated fatty acids? (1)
- A. The presence of long chain of carbon
 - B. ✓ **The presence of one or more double bonds**
 - C. The presence of large number of hydrogen atoms
 - D. Their occurrence as solid at room temperature

Answer: B

Saturated means every carbon in the chain is holding as many hydrogen atoms as it can, joined only by single bonds. An unsaturated fatty acid has one or more carbon to carbon double bonds instead, which is where the missing hydrogens would have been. Each double bond puts a bend in the chain so the molecules do not pack tightly, which is why these fats are oils at room temperature. Option D tempts by naming that very property but in reverse: being solid at room temperature describes the saturated fats.

22. Which of the following pairs of molecule are known to have catalytic activity? (1)
- A. Lipids and proteins
 - B. carbohydrate and proteins
 - C. ✓ **protein and RNAs**
 - D. protein and DNAs

Answer: C

Almost all catalysts in the cell are proteins, which is what enzymes are. A small number are made of RNA instead: these are called ribozymes, and the ribosome itself joins amino acids using an RNA catalyst rather than a protein one. So protein and RNA are the two catalytic molecules. DNA is the tempting partner because it is the other nucleic acid, but its double helix is a stable store of information and does not fold into an active site.

23. If a suspension of a mixture of cellular organelle is spun in a centrifuge, which organelle settles to the bottom first? (1)
- A. Mitochondria
 - B. ✓ **Nuclei**
 - C. Chloroplasts
 - D. Ribosomes

Answer: B

In a centrifuge the heaviest and densest particles reach the bottom first, at the lowest speed and the shortest spin. The nucleus is by far the largest organelle in the cell, so it pellets first, and cell fractionation is done in exactly this order by spinning faster in stages. Mitochondria are the tempting answer because they are large enough to see, but they are much smaller than nuclei and need a faster spin to come down.

24. During chemiosmosis, what substance diffuses from one side to the other side of the membrane? (1)
- A. Water molecules
 - B. ✓ **protons**
 - C. Electrons
 - D. ATP molecules

Answer: B

Chemiosmosis is the movement of protons, that is hydrogen ions H^+ , across a membrane. The electron transport chain first pumps protons to one side so that they build up there, and the protons then flow back through ATP synthase down their concentration gradient. Electrons are the tempting answer because they are moving at the same time, but they travel along the carriers inside the membrane and never cross from one side to the other as a diffusing substance.

25. Which of the following human diseases can be prevented by taking proper diets? (1)

- A. Degenerative diseases
- B. Genetic diseases
- C. Social diseases
- D. ✓ **Deficiency diseases**

Answer: D

Deficiency diseases are caused by a nutrient missing from the food a person eats, so supplying that nutrient prevents them. Scurvy comes from lack of vitamin C, rickets from lack of vitamin D, kwashiorkor from lack of protein and anaemia often from lack of iron, and all of them are avoided by eating a balanced diet. Genetic diseases are the tempting answer because diet can help someone manage them, but the fault is in the DNA the person was born with, so no food can prevent it.

26. When two species are compared ,which of the following sources of evidence is least informative about the degree of relationships between the species? (1)

- A. Nucleotide sequence of DNAs
- B. Amino acid sequence of proteins
- C. ✓ **Glucose sequence of polysaccharides**
- D. DNA-DNA hybridization

Answer: C

A polysaccharide such as starch or cellulose is the same sugar, glucose, repeated over and over. Because the units do not vary, there is no sequence to compare between two species, so the molecule carries almost no information about how closely they are related. The amino acid sequence of proteins is the tempting answer because it is also a comparison of building blocks, but there are twenty different amino acids, so their order differs between species and the number of differences measures how far apart the species are.

27. Which of the following practices dose NOT normally transmit HIV? (1)

- A. Sexual intercourse through anus
- B. sharing injection needles
- C. Blood transfusion
- D. ✓ **shaking hands**

Answer: D

HIV spreads only when infected body fluids such as blood, semen, vaginal fluid or breast milk reach the blood or the mucous membranes of another person. The virus dies quickly outside the body and does not pass through unbroken skin, so shaking hands, sharing food, hugging and using the same toilet carry no risk. Blood transfusion is the tempting answer because it feels like ordinary medical care, but untested blood puts the virus straight into the bloodstream, which is why every unit is screened.

28. What is the important role played by microorganism such as bacteria and fungi in the ecosystem? (1)

- A. ?Antibiotic production
- B. ✓ **Recycling of nutrients**
- C. Forming organic substance
- D. Supplying energy to the ecosystem

Answer: B

Bacteria and fungi are the decomposers. They break down dead bodies, fallen leaves and waste, and in doing so they release the carbon, nitrogen and minerals locked in that material back into the soil and the air where plants can take them up again. Without them the nutrients would stay trapped in dead matter and the cycle would stop. Forming organic substances is the tempting answer, but building organic matter from simple raw materials is the work of green plants and other producers.

29. Which of the following theories explains evolutionary changes of living things in terms of changes in their allele frequencies? (1)

- A. Darwin's natural selection
- B. Spontaneous generation
- C. Inheritance of acquired characteristics
- D. ✓ **Neo-Darwinism**

Answer: D

Neo-Darwinism, also called the modern synthesis, joins Darwin's natural selection to the genetics that came after him. It describes evolution as a shift in how common each allele is in a population's gene pool from one generation to the next. Darwin's natural selection is the tempting answer because the mechanism is the same, but Darwin had no knowledge of genes or alleles, so he could explain the process only in terms of inherited characters.

30. Which of the following is an important function of the Golgi apparatus? (1)

- A. Protein synthesis
- B. ✓ **packaging of proteins**
- C. Removing of debris from cell
- D. Storage of waste materials not needed by the cell

Answer: B

The Golgi apparatus receives proteins made on the rough endoplasmic reticulum, finishes them by adding sugar or lipid groups, sorts them by destination and wraps them in vesicles for delivery inside or outside the cell. Protein synthesis is the tempting answer because the Golgi handles proteins all day, but the joining of amino acids happens on ribosomes, and the protein reaches the Golgi only after it has been made.

31. Which of the following is NOT usually true as an ecological succession progresses to advanced seral stages ? (1)

- A. More ecological niches are formed
- B. Species become more diverse
- C. The depth of the soil increase
- D. ✓ **Less population is supported**

Answer: D

As succession advances the habitat gets richer, not poorer. Soil deepens, more kinds of plants and animals arrive, more niches open up and the amount of life the area can support goes up, so saying less population is supported is the statement that is not true. Deeper soil is the tempting answer if the question is read too fast, but soil building is exactly what the earlier stages do for the later ones, so that statement is true and is not what the question asks for.

32. One of the following is an important cause of gene of gene mutation. (1)

- A. Old age
- B. Alcoholic drinks
- C. Smoking
- D. ✓ **Radiation**

Answer: D

Ionising radiation such as X rays, gamma rays and ultraviolet light carries enough energy to break DNA strands and alter bases directly, and the change is copied into every daughter cell after that. This is why radiation is the standard example of a mutagen in the syllabus. Smoking is the tempting answer because tobacco smoke really does carry chemicals that damage DNA, but that harm reaches mainly the cells of the airway of a person who smokes, while radiation can reach the cells of anyone, including the sex cells that pass the change to children.

33. What is the reproductive isolating mechanism called if two species of frogs do not interbreed because they cannot understand the mating calls of one another (1)

- A. Seasonal isolation
- B. ✓ **Behavioral isolation**
- C. Temporal isolation
- D. isolation by distance

Answer: B

Behavioural isolation is the barrier that appears when two populations no longer recognise each other's courtship signals. A female frog answers only the call of her own species, so even though the two species live in the same pond at the same time and could physically mate, no mating takes place. Temporal or seasonal isolation is the tempting answer, but that would mean the two species breed at different times of the year or of the day, and here the problem is the call and not the timing.

34. How many chromosomes do humans inherit from each of their parents? (1)

- A. ✓ **23 chromosome**
- B. 23 pairs of chromosome
- C. 46 chromosome
- D. 46 pairs of chromosome

Answer: A

A gamete is haploid, so a sperm carries 23 chromosomes and an egg carries 23. When they join at fertilisation the zygote has $23 + 23 = 46$ chromosomes, arranged as 23 pairs with one member of each pair from each parent. That is why the question asks about one parent and the answer is 23. Option B tempts because 23 pairs is a familiar phrase, but 23 pairs is 46 chromosomes, which is the child's whole set and not what one parent gave.

35. In which one of the four phases of population growth is the number of the population the highest? (1)

- A. Lag phase
- B. log phase
- C. ✓ **Constant phase**
- D. Decline phase

Answer: C

A population growth curve runs through four stages: a lag phase while numbers build slowly, a log phase of rapid increase, a constant or stationary phase where births balance deaths, and a decline phase. Numbers keep rising all through the log phase and stop rising at the top, so the highest count is in the constant phase. The log phase is the tempting answer because that is where growth is fastest, but fastest growth is not the same as the largest number: the population is still on its way up.

36. Which of the following is NOT true about the gene called SRY? (1)

- A. It is found on the Y-chromosome.
- B. It determines maleness.
- C. Testes develop in its presence.
- D. ✓ **Female have two copies of this gene.**

Answer: D

SRY sits on the Y chromosome, and a female is XX, so a female has no Y chromosome and therefore no copy of the gene at all. Saying she has two copies is the statement that is not true. The other three are correct: the gene is on the Y, its protein switches the early gonad into testes and its presence is what makes an embryo male. Option C tempts because it sounds like a detail worth doubting, but testes developing in the presence of SRY is exactly what the gene does.

37. To which of the following groups do those bacteriophages that integrate their DNA into the chromosome of their bacterial host belong? (1)

- A. Virulent viruses
- B. Lytic viruses
- C. ✓ **Lysogenic viruses**
- D. Non-parasitic viruses

Answer: C

A lysogenic phage does not destroy its host at once. It inserts its DNA into the bacterial chromosome as a prophage, which is then copied along with the host DNA every time the bacterium divides, and only later may it leave and start destroying cells. Lytic viruses are the tempting answer because they are the other half of the same story, but a lytic phage copies itself straight away and bursts the cell without ever joining the host chromosome.

38. What do we call the learned behavior if a mouse that had just escaped from the mouth of a cat jumped violently at a slight touch by a trivial object? (1)
- A. Latent learning
B. ✓ **Sensitization**
C. Conditioning
D. Imprinting

Answer: B

Sensitization is a simple form of learning in which a strong or frightening event makes an animal respond far more strongly than usual to any small stimulus that follows. The mouse has escaped a cat, so an ordinary touch now sets off a violent jump. Conditioning is the tempting answer, but conditioning needs two stimuli paired again and again until the animal links them, and here one bad experience has raised the response to everything.

39. In which of the following features are eukaryotic cells distinguished from prokaryotic cells? (1)
- A. ✓ **They have mitochondria**
B. ✖ Their nuclei lack membrane
C. They have no DNA
D. They have smallest ribosomes

Answer: A

Eukaryotic cells contain membrane bound organelles, and mitochondria are the clearest example: no prokaryote has them. A eukaryote also has a true nucleus enclosed by a nuclear membrane, an endoplasmic reticulum and a Golgi apparatus. Option B is tempting because it mentions the nucleus, but it states the opposite of the truth for eukaryotes and is not even accurate for prokaryotes, which have no nucleus to speak of.

40. What will happen if human red blood cells are kept in a hypotonic solution? (1)
- A. Lose water by osmosis and burst
B. Lose water by osmosis and shrink
C. ✓ **Take in water by osmosis ,swell and burst**
D. Take in water by osmosis ,swell and remain turgid

Answer: C

A hypotonic solution has less solute and more free water than the cell, so water moves into the cell by osmosis. A red blood cell has only a thin membrane and no cell wall, so as water keeps entering the cell swells until the membrane tears, which is called haemolysis. Option D is tempting because that is what happens to a plant cell in the same solution, but a plant cell survives because its rigid cellulose wall pushes back and holds the cell turgid.

41. Which of the following field equipment is used to determine an exact location of a place? (1)
- A. Theodolite
B. ✓ **Global positioning system**
C. Field microscope
D. Field PH kit

Answer: B

A global positioning system receiver picks up signals from satellites and works out latitude and longitude, which is exactly what you need to record where a plant or animal was found and to return to the same spot later. A theodolite is the tempting answer because it is the other survey instrument in the list, but it measures angles from where you are already standing, so it gives heights and distances rather than a position on the earth.

42. The sheep 'dolly' is an example of which biotechnological manipulation of animals by human? (1)
- A. Transgenic animal
B. Genetically engineered animal
C. ✓ **Cloned animal**
D. Hybrid animal

Answer: C

Dolly was made by somatic cell nuclear transfer. The nucleus of a body cell taken from one adult sheep was placed into an egg cell whose own nucleus had been removed, and the embryo that grew carried the same nuclear DNA as that adult, so Dolly was a clone. Genetically engineered animal is the tempting answer because the work was done in a laboratory, but no gene was cut, changed or inserted: the whole existing set of genes was copied as it was.

43. Among the following ,which one is the best criterion to show that two population belong to same species? (1)
- A. Morphological similarity
 - B. Physiologically similarity
 - C. Inhabiting the same geographic area
 - D. ✓ **Production of fertile offspring**

Answer: D

Two populations belong to the same species if their members can breed with each other and produce offspring that are themselves fertile. This is the biological species concept, and the fertile part matters: a horse and a donkey can produce a mule, but the mule cannot breed, so the parents remain two species. Morphological similarity is the tempting answer, but separate species can look almost identical while breeds of one species can look very different.

44. In the process of the evolution of life on earth , which of the following four processes evolved last? (1)
- A. Photosynthesis
 - B. ✓ **Aerobic respiration**
 - C. chemosynthesis
 - D. Photo-autotrophism

Answer: B

Aerobic respiration needs free oxygen, and there was almost none in the early atmosphere. Chemosynthesis came first, then photosynthetic bacteria began releasing oxygen as a waste product, and only once that oxygen had built up could organisms evolve to use it for respiration. Photosynthesis is the tempting answer because it seems the more advanced process, but it is the one that had to come first: it supplied the oxygen the last step depends on.

45. What is a theory in biology? (1)
- A. The outcome of an experiment
 - B. A proof that shows the hypothesis is true
 - C. ✓ **A hypothesis supported by experiments and/or observations.**
 - D. An opinion or educated guess resulting from observations.

Answer: C

A theory in science is a hypothesis that has been tested many times by different people and has been supported by the results every time, so it becomes the accepted explanation for a wide set of observations. Option B is tempting because it sounds stronger, but science does not prove a hypothesis true for ever: new evidence can always force a theory to be changed, so we say it is supported rather than proved.

46. For which of the following is a theodolite used in biology education? (1)
- A. ✓ **Measuring the height of trees**
 - B. Recording positions where a species is found
 - C. Measuring the rate of flow of water in a cell.
 - D. Measuring the PH of water or soil.

Answer: A

A theodolite measures angles precisely. In a field study you stand a known distance from a tree, measure the angle from the horizontal up to the top, and calculate the height with $h = d \tan \theta$, adding the height of the instrument itself. That gives the height of a tree far too tall to reach with a tape. Recording positions is the tempting answer, but that job belongs to a GPS receiver, which reads latitude and longitude directly.

47. What is the name of the suger found in milk? (1)
- A. Glucose
 - B. ✓ **Lactose**
 - C. Maltose
 - D. Sucrose

Answer: B

Lactose is the sugar of milk. It is a disaccharide of glucose and galactose, and the enzyme lactase in the small intestine splits it so the two simple sugars can be absorbed. People whose lactase level falls after childhood get stomach pain from milk, which is lactose intolerance. Sucrose is the tempting answer because it is the sugar everyone knows from the kitchen, but sucrose comes from sugarcane and beet, not from milk.

48. To which class of enzymes do the digestive enzymes belong? (1)

- A. Esterases
- B. Transferases
- C. ✓ **Hydrolases**
- D. Isomerases

Answer: C

Digestive enzymes are hydrolases. Every one of them breaks a large molecule by adding water across the bond that holds two units together: amylase does this to starch, protease to protein and lipase to fat. The reaction is hydrolysis, so the class is named after it. Esterases are the tempting answer because lipase does break an ester bond, but that covers only the fat digesting enzymes, while the question asks about the whole group.

49. Which of the following crops is considered to be the best choice for a better balance of essential amino acids as a human diet? (1)

- A. Maize
- B. ✓ **Quinoa**
- C. Rice
- D. Wheat

Answer: B

Quinoa is the best choice here because its protein contains all the essential amino acids in amounts close to what the body needs, which is unusual for a plant food. Essential amino acids are the ones the body cannot make for itself, so they have to arrive in the diet. Maize is the tempting answer because it is the staple many families rely on, but cereal protein is short of lysine, so a diet built on it alone leaves a gap unless beans or other pulses are eaten with it.

50. What is the main reason for the high species richness of plants and mammals observed in Ethiopia? (1)

- A. Lack of predators
- B. Lack of disturbance
- C. ✓ **Presence of several biomes within the country**
- D. Efficient management of the ecological resources

Answer: C

Ethiopia holds many biomes inside one country. The land rises from the Danakil depression below sea level to peaks above 4000 metres, and each band of altitude and rainfall brings its own climate, so desert, savanna, montane forest, afroalpine moorland and wetland all occur here. More habitats means more kinds of plants and animals, including species found nowhere else. Lack of predators is the tempting answer, but predators are part of a healthy ecosystem and their absence would reduce diversity rather than raise it.

51. In which type of solution is the water potential more negative than in the cells? (1)

- A. Hypotonic
- B. ✓ **hyper-tonic**
- C. Isotonic
- D. equal solute and solvent concentration

Answer: B

A hypertonic solution holds more dissolved solute than the cell does. Solute lowers water potential, so the solution has a more negative water potential than the cell contents, and water then moves out of the cell down that gradient. Hypotonic is the tempting answer, but a hypotonic solution has less solute and therefore a higher, less negative water potential, so water moves the other way and enters the cell.

52. Which of the following paired organelles are membrane-bound? (1)

- A. Ribosomes and peroxisomes
- B. Chloroplasts and ribosomes
- C. Mitochondria and ribosome
- D. ✓ **chloroplasts and mitochondria**

Answer: D

Chloroplasts and mitochondria are each wrapped in a double membrane, and both also carry folded membranes inside, the thylakoids and the cristae, where their energy reactions take place. Ribosomes have no membrane at all: they are two blocks of RNA and protein, which is why every option pairing a ribosome with something else fails. Option A is the tempting one because a peroxisome is genuinely membrane bound, but its partner in that pair is the ribosome, so the pair as a whole is wrong.

53. Most cell membrane are primarily composed of which compounds (1)

- A. ✓ **Proteins and lipids** B. DNA and ATP
C. Chitin and starch D. Nucleotides and amino acids

Answer: A

The fluid mosaic model describes a membrane as a double layer of lipid with proteins floating in it, so lipids and proteins together make up nearly all of it. The lipid layer keeps water soluble substances from crossing, and the proteins do the work of transport, recognition and signalling. Option D is tempting because nucleotides and amino acids sound like the right level of detail, but those are the building blocks of DNA and of protein, and a membrane is not built from them directly.

54. Which group of micro-organisms cause the diseases known as athletes foot? (1)

- A. Bacteria B. ✓ **Fungi**
C. Protozoa D. Viruses

Answer: B

Athlete's foot is caused by fungi, the dermatophytes that feed on keratin in the outer layer of skin. They grow best where the skin stays warm and damp, which is why the skin between the toes is the usual place and why keeping the feet dry helps. The cure is an antifungal cream. Bacteria are the tempting answer because skin infections are often bacterial, but antibiotics do nothing here, and the peeling, itching ring shaped patch is typical of a fungus.

55. Choose the one that is different from all the others. (1)

- A. Genetically modified organisms B. Genetically engineered organisms
C. ✓ **Pathogenic organisms** D. Transgenic organisms

Answer: C

Genetically modified, genetically engineered and transgenic all describe an organism whose DNA has been changed on purpose by people in a laboratory, so those three belong together. Pathogenic means something else entirely: it means the organism causes disease, which says nothing about whether its genes were altered. Transgenic is the tempting odd one out because the word looks the most technical, but it names the same idea as the other two, with a gene taken from a different species.

56. Under which of the following groups can the fungi be more conveniently placed? (1)

- A. Autotrophs B. ✓ **Heterotrophs**
C. Prokaryotes D. Plants

Answer: B

Fungi cannot make their own food because they have no chlorophyll and do not photosynthesise. Instead they release digestive enzymes onto dead or living material outside their body and absorb the small molecules that result, which makes them heterotrophs. Plants are the tempting answer because fungi are fixed in one place, grow from a base and were once classified with plants, but a plant feeds itself from sunlight and a fungus cannot.

57. What is the type of community called when it has reached the final and most complex stage of a succession (1)

- A. Pioneer community B. seral community
C. ✓ **Climax community** D. secondary community

Answer: C

Succession runs from a pioneer community through a series of seral stages to a community that stops changing because it is in balance with the climate and soil of that place. That last stable stage is the climax community, and in much of the Ethiopian highlands it would be forest. The seral community is the tempting answer because those stages are also communities, but each one is on its way to being replaced by the next, so none of them is final.

58. Which of the following is an ecosystem

(1)

- A. ✓ **A Tropical Rain forest**
- B. The African continent
- C. All the organisms in a given area
- D. The non-living components of an environment

Answer: A

An ecosystem is all the living things in an area together with the non living surroundings they depend on, and the flow of energy and nutrients between the two. A tropical rain forest fits this: it has its plants and animals plus the soil, water, air and sunlight they live in. Option C is the tempting answer, but all the organisms in an area with the physical surroundings left out is a community, which is only one half of an ecosystem.

59. Which of the following characteristics can show the evolutionary relationships among organism?

(1)

- A. Structures having similar function
- B. structures having same size
- C. ✓ **structure having common origin**
- D. structure having different origin

Answer: C

Structures that share a common origin are called homologous, and they are the evidence of shared ancestry. The arm of a human, the flipper of a whale, the wing of a bat and the leg of a horse are all built from the same set of bones inherited from one ancestor, even though they now do different jobs. Option A is the tempting one, but structures with a similar function and different origins, like the wing of an insect and the wing of a bird, are analogous and show only that two lines met the same problem.

60. The group of the Ethiopian wolf does NOT contribute to territory marking with their urine containing pheromones is _____.

- A. Adult males
- B. Adult females
- C. sub-adult males
- D. ✓ **Sub-adult females**

Answer: D

Ethiopian wolves live in packs that defend a territory, and the pack members patrol its edges and mark them with urine carrying pheromones that warn neighbouring packs off. Adult males, adult females and sub-adult males all take part in this marking. Sub-adult females are the exception because they are the ones that leave to look for a place in another pack, so they do not invest in defending a territory they are about to give up. Sub-adult males are the tempting answer, but young males normally stay in the pack they were born into, so they do help hold the boundary.

61. In which of the following are flowers and fruits found?

(1)

- A. Ferns and relative
- B. Gymnosperms and ferns
- C. Mosses and conifers
- D. ✓ **monocots and dicots**

Answer: D

Flowers and fruits are the defining features of the angiosperms, the flowering plants, and monocots and dicots are the two groups the angiosperms are divided into. The flower is the reproductive structure and the fruit is the ripened ovary that protects and spreads the seeds. Gymnosperms are the tempting answer because they also make seeds, but their seeds sit exposed on the scales of a cone, with no true flower and no fruit around them.

62. In a cross between heterozygous what proportion is expected to be homozygous recessive? (1)

- A. ✓ 25% B. 50%
C. 75% D. 100%

Answer: A

Cross two heterozygotes, $Aa \times Aa$. Each parent passes on A or a with equal chance, so the offspring come out as 1 AA : 2 Aa : 1 aa . The homozygous recessive is the aa group, one box out of four, which is $\frac{1}{4} = 25\%$. The answer 50% tempts because half the offspring are heterozygous, but the question asks for the ones carrying two recessive alleles, not one.

63. Gene silencing is the function of one of the following molecules. (1)

- A. dsRNA B. mRNA
C. ✓ siRNA D. tRNA

Answer: C

Small interfering RNA, written siRNA, is the molecule that silences genes. It is a short RNA that is loaded into a protein complex and guides it to any mRNA with a matching sequence, and that mRNA is then cut up before it can be translated, so the gene's protein is never made. mRNA is the tempting answer because it is the RNA everyone knows, but mRNA carries the message to be read: in gene silencing it is the target, not the tool.

64. Which processes is held responsible for chronic myelogenous leukemia? (1)

- A. ✓ Translocation B. Translation
C. Transcription D. Duplication

Answer: A

Chronic myelogenous leukemia is caused by a translocation, a swap of material between chromosome 9 and chromosome 22. The shortened chromosome 22 that results is called the Philadelphia chromosome, and the join creates a fused gene whose protein drives white blood cells to divide without stopping. Translation is the tempting answer because the two words look alike, but translation is the normal building of a protein from mRNA and is not a change to a chromosome.

65. Two parents of genotype Aa are cross-bred. The alleles show complete dominance. What proportion of the offspring will phenotypically look like their parents? (1)

- A. 0 B. 1/4
C. 1/2 D. ✓ 3/4

Answer: D

Both parents are Aa , so each of them shows the dominant phenotype. Their offspring come out 1 AA : 2 Aa : 1 aa , and every offspring carrying at least one A looks the same as the parents because dominance is complete. That is three boxes out of four, so $\frac{3}{4}$. The answer $\frac{1}{2}$ tempts if only the Aa offspring are counted, but the AA offspring look exactly like their parents too.

66. Which one of the following concepts contains all the other ? (1)

- A. Species B. Genus
C. population D. ✓ community

Answer: D

Work up the levels. A species is one kind of organism, a genus is a group of closely related species, a population is the members of one species living in one place, and a community is every population living together in that place. The community therefore holds populations of many species from many genera, so it contains all the others. Genus is the tempting answer because a genus does contain several species, but a genus is a rank used for naming and it does not contain the populations or the other genera living alongside it.

67. Choose the one that is NOT a requirement of all living things. (1)

- A. ✓ **Ability to think**
- B. organization of parts
- C. Response to the stimuli
- D. Maintenance of internal constancy

Answer: A

The characteristics shared by all living things are nutrition, respiration, movement, growth, reproduction, excretion, response to stimuli and keeping conditions steady inside the body. Thinking is not on that list: a bacterium, a maize plant and a mushroom are all alive and none of them thinks. Response to stimuli is the tempting answer because it sounds close to thinking, but a plant bending towards light is responding without any nervous system at all, so every organism can manage it.

68. What is the advantage of using HAART (highly active antiretroviral therapy) for the treatment of HIV (1)

- A. It gives a lasting immunity to HIV
- B. It prevents mutation of HIV.
- C. It prevents re-infection by HIV.
- D. ✓ **It helps to break the life cycle of HIV.**

Answer: D

Highly active antiretroviral therapy uses several drugs together, each blocking a different step in the way HIV copies itself, so the virus is stopped at more than one point in its life cycle. The viral load falls low enough for the immune system to recover, and using several drugs at once makes it far harder for a resistant strain to take over. Option A is tempting because the person gets better, but the drugs give no immunity: stop taking them and the virus multiplies again.

69. In which of its contents RNA differs from DNA? (1)

- A. Deoxyribose and guanine
- B. ✓ **Ribose and uracil**
- C. Ribose and uracil
- D. Phosphate and adenine

Answer: B

70. Which of the following cell types can be rich in lysosomes? (1)

- A. Red blood cells
- B. Nerve cells
- C. ✓ **Phagocytic cells**
- D. Muscle cells

Answer: C

Phagocytic white blood cells swallow bacteria and cell debris into a vesicle, and lysosomes then fuse with that vesicle and empty their digestive enzymes onto the contents. A cell that does this all day needs a large stock of lysosomes ready to use. Nerve cells are the tempting answer because they are large and busy, but their work is carrying electrical signals, so they have no reason to hold a store of digestive enzymes.

71. What can one conclude about the contents of the food stuff if a mixture of Benedict solution and foodstuff remain blue after heating ? (1)

- A. It contains proteins
- B. It lacks starch
- C. It contains fats
- D. ✓ **It lacks reducing sugar**

Answer: D

Benedict's solution is blue because of the copper it contains, and a reducing sugar such as glucose or maltose changes that copper on heating, so the mixture turns green, then yellow, then orange and brick red as the amount of sugar rises. Staying blue means nothing reacted, so no reducing sugar is present. Option B is tempting because it also names a food missing from the sample, but starch is tested with iodine solution and Benedict's says nothing about it.

72. Which of the following types of enzyme inhibitions can be removed when the end product of the metabolic pathway is depleted? (1)

- A. ✓ **Allosteric inhibition** B. Non-reversible inhibition
C. competitive inhibition D. Reversible competitive inhibition

Answer: A

In end product inhibition the final product of a pathway binds to an allosteric site on an early enzyme, which changes the enzyme's shape and slows it down. The binding is loose and reversible, so as the cell uses up the product the inhibitor leaves the enzyme and the pathway starts running again. That is how a cell makes only what it needs. Reversible competitive inhibition is the tempting answer because it can also be undone, but that inhibitor sits in the active site itself and is pushed out by adding more substrate, not by using up the end product.

73. If red blood cells shrink when placed in a certain solution, what is the strength of the solution relative to the strength of the protoplasm of the cells? (1)

- A. Hypotonic B. Isotonic
C. ✓ **Hyper tonic** D. Isoosmotic

Answer: C

Shrinking means water has left the cells, and water leaves by osmosis when the surrounding solution holds more solute than the cell contents. That solution is hypertonic to the cell, and in red blood cells the shrunken, notched appearance that results is called crenation. Hypotonic is the tempting answer, but a hypotonic solution sends water into the cell, so the cell would swell and burst instead of shrinking.

74. Which of the following is NOT true about photo system-II? (1)

- A. Its reaction center molecule is P680.
B. Its passes its excited electrons to photo system-I
C. ✓ **The energy lost from its excited electrons reduces NADP**
D. It replenishes its lost electrons from photolysis of water.

Answer: C

The electrons that photosystem II loses are passed to photosystem I through the carrier chain, and the energy they release on the way is used to pump protons and make ATP. NADP is reduced at the end of the chain by electrons coming out of photosystem I, not from photosystem II, so option C is the statement that is not true. Option B tempts because it sounds like the wrong direction of flow, but the numbering is historical: photosystem II really does feed its electrons to photosystem I.

75. On which one of the following principle are most of the anti-HIV drugs currently in use working? (1)

- A. ✓ **Inhibition of enzyme action** B. Degradation of viral RNA
C. Digesting of viral particles D. Phagocytosis of the virus

Answer: A

Most anti-HIV drugs work by blocking the enzymes the virus needs. Reverse transcriptase inhibitors stop viral RNA being copied into DNA, integrase inhibitors stop that DNA joining the host chromosome and protease inhibitors stop the new viral proteins being cut into working pieces, so in each case an enzyme is put out of action. Option D is tempting because phagocytosis really does destroy invaders, but that is the work of the body's own white blood cells and not something a drug molecule does.

76. Among the following mating, where the ABO blood genotype of the partners are shown, identify the mating in which all the children will have the same blood type. (1)

- A. AO x BO
B. ✓ AA x OO
C. AB x BO
D. BB x AO

Answer: B

Write out the cross. One parent is *AA* so every gamete carries *A*, and the other is *OO* so every gamete carries *O*. Every child is therefore *AO*, and because *A* is dominant over *O* they all have blood group A. Option A tempts because *AO* × *BO* looks like a tidy cross, but it gives *AB*, *AO*, *BO* and *OO*, which is all four blood groups in one family.

77. If a new mutant allele arises in a certain population, which of the following factors determines if the allele is going to be adaptive or non-adaptive (1)

- A. ✓ The environment in which the population lives.
B. The rate at which the gene mutates.
C. The population in which the gene is found
D. The use and disuse of the gene by the population

Answer: A

Whether a new allele helps or harms depends on the surroundings the population lives in. The sickle cell allele is a good example: it causes serious illness, but where malaria is common a carrier of one copy survives malaria better, so the same allele is useful in one place and harmful in another. Option B is tempting because mutation rate is a real genetic quantity, but it only decides how often the allele appears, and not whether the individuals carrying it survive.

78. Which of the following is the correct route that connects a stimulus and a response? (1)

- A. ✓ Receptor → coordinator → effector
B. Coordinator → receptor → effector
C. Receptor → effector → coordinator
D. Effector → receptor → coordinator

Answer: A

A stimulus is picked up by a receptor, such as the skin, the eye or the ear. The receptor sends the information to a coordinator, the brain or spinal cord, which decides what to do, and the coordinator then sends an instruction to an effector, a muscle or a gland, which produces the response. Option C is the tempting one because it starts correctly with the receptor, but it sends the message to the effector before anything has processed it, so nothing would decide what the response should be.

79. In which of the following compound are both members of the pair are polymers of carbohydrates that naturally occur in plants only? (1)

- A. Starch and chitin
B. ✓ Starch and cellulose
C. Glycogen and cellulose
D. Glycogen and chitin

Answer: B

Starch and cellulose are both polymers of glucose and both are made by plants: starch is the store of food and cellulose builds the cell wall. The two differ only in how the glucose units are joined, which is why one can be digested and the other cannot. Glycogen paired with cellulose is the tempting answer because glycogen is also a glucose polymer, but glycogen is the storage carbohydrate of animals and fungi, so the pair is not plant only. Chitin fails for the same reason and is not made of plain glucose either.

80. Which of the following is generally expected to give better health benefits when presence in human diet? (1)
- A. Animal fat
 - B. Mono unsaturated fatty acid
 - C. Saturated fatty acid
 - D. ✓ **Polyunsaturated fatty acid**

Answer: D

Polyunsaturated fatty acids carry several carbon to carbon double bonds, and they include the essential fatty acids of the omega-3 and omega-6 families, which the body cannot build for itself and has to take from food. They also help keep cholesterol in the blood at a healthier level. Monounsaturated fatty acids are the tempting answer because they are genuinely good for health too, but with only one double bond they do not supply the essential fatty acids, so they cannot replace the polyunsaturated ones in the diet.

81. If the age pyramid of a certain country is narrowing at the base ,what does this tell about the trend of the population size of the country? The population size is: (1)
- A. ✓ **declining**
 - B. growing fast
 - C. increasing slowly
 - D. stabilizing

Answer: A

An age pyramid is drawn with the youngest people at the bottom, so a narrow base means few children compared with the adults above them. As those small young groups grow up they cannot replace the larger older groups, so total numbers fall over time and the population is declining. Growing fast is the tempting answer because a pyramid is a picture of growth, but a fast growing country has a wide base with each generation larger than the one before it.

82. Suppose the amino acid coding region in a mRNA is 1200 nucleotides long, how long is the protein in terms of amino acid number? (1)
- A. 1200 amino acids
 - B. 600 amino acids
 - C. ✓ **400 amino acids**
 - D. 300 amino acids

Answer: C

Three nucleotides make one codon, and one codon codes for one amino acid. So divide the length of the coding region by three: $1200 \div 3 = 400$ amino acids. The answer 600 tempts if the nucleotides are divided by two, which would be reading the bases in pairs, but four bases in pairs give only $4^2 = 16$ combinations, too few for twenty amino acids, which is why the genetic code works in threes.

83. If a new anti-HIV drug is to be developed to prevent the virus from entering the host cell, which one of the following processes should the drug target? (1)
- A. Reverse transcription
 - B. ✓ **Binding of Gp120 and CD4**
 - C. Integration of viral DNA in to host DNA
 - D. Assembly of viral parts in to a whole virus

Answer: B

HIV gets into a cell by first sticking to it. The gp120 protein on the virus surface binds the CD4 receptor on the helper T cell, then a co-receptor is engaged and the membranes fuse so the viral core enters. A drug that blocks that binding keeps the virus outside the cell entirely. Reverse transcription is the tempting answer because many HIV drugs do target it, but that step happens after the virus is already inside, so blocking it does not prevent entry.

89. Which of the following is a recently developed active area of research in biology today? (1)
- A. Taxonomic study
 - B. study about the cell theory
 - C. Ecological research
 - D. ✓ **stem cell research**

Answer: D

Stem cell research is the recent and fast moving field here. Stem cells can divide and turn into many different cell types, and scientists are working on using them to repair damaged tissue, to test drugs and to study how disease develops. Ecological research is the tempting answer because it deals with problems in the news today, but ecology has been a full branch of biology for more than a century, so it is not the recently opened field.

90. Where does the light dependent reaction of photosynthesis occur in the chloroplast? (1)
- A. ✓ **In the thylakoid membrane**
 - B. In the fluid of the stroma
 - C. In all parts of the chloroplast
 - D. In the stomatal opening

Answer: A

The light dependent reaction happens in the thylakoid membranes. The chlorophyll is held there inside the photosystems, water is split there, the electron carriers sit in that membrane and the ATP synthase that uses the proton gradient is built into it. The stroma is the tempting answer because it is the other main part of the chloroplast, but the stroma is the fluid where the light independent reaction fixes carbon dioxide in the Calvin cycle.

91. In which process is ATP generated during short distance high speed running? (1)
- A. Aerobic respiration
 - B. Mitochondrial energy transformation
 - C. ✓ **Anaerobic respiration**
 - D. The krebs cycle

Answer: C

In a short sprint the muscles need ATP faster than the blood can deliver oxygen to them. They fall back on anaerobic respiration, where glucose is broken down in the cytoplasm without oxygen to give a small amount of ATP very quickly, with lactic acid left behind as the waste that makes the muscles ache. Aerobic respiration is the tempting answer because it yields far more ATP per glucose, but it is too slow and too dependent on oxygen supply to carry a sprint.

92. Which one of the following choices shows the end products of a mitotic cell division? (1)
- A. Gametes and ordinary cells
 - B. Four genetically different cells
 - C. Two genetically different cells
 - D. ✓ **Two genetically identical cells**

Answer: D

Mitosis copies the DNA once and then divides it once, so the parent cell gives two daughter cells with the same number of chromosomes and the same genes as each other and as the parent. That is why mitosis is used for growth, for repair and for asexual reproduction. Option B is the tempting one because it describes a real process, but four genetically different cells is the outcome of meiosis, which halves the chromosome number to make gametes.

93. What exactly happens during a substitution mutation? (1)
- A. ✓ **One base is replaced by a different base.**
 - B. An extra base is added during DNA replication
 - C. A base is missed out during DNA replication
 - D. Change occurs in the arrangement or structure of a chromosome

Answer: A

In a substitution mutation one base in the DNA is swapped for a different base, for example an A where a G should be. The length of the gene does not change, so at most one codon is affected and the protein may lose or change a single amino acid, or may not change at all if the new codon means the same thing. Option B is tempting because it is also a small change to one base, but adding a base is an insertion, and it shifts the whole reading frame after that point so the rest of the protein comes out wrong.

94. During the course of evolution, which of the following events came before all the others? (1)
- A. Origin of dinosaurs and other reptiles.
 - B. ✓ **Availability of free oxygen in the atmosphere**
 - C. Origin of the oldest eukaryotic organism
 - D. origin of the first multicellular animals and plants.

Answer: B

Free oxygen appeared first, roughly 2.4 billion years ago, when photosynthesising bacteria had been releasing it long enough for it to build up in the air. The oxygen made aerobic respiration possible, and only after that came the first eukaryotic cells, then the first multicellular plants and animals, and much later the reptiles and dinosaurs. The oldest eukaryotic organism is the tempting answer because eukaryotes feel like the beginning of familiar life, but they arrived after the air already held oxygen.

95. What kind of natural selection is at work in a situation where individual at both extreme ends of the range get better survival advantages than those around the middle? (1)
- A. Stabilizing selection
 - B. Direction selection extremes
 - C. ✓ **Disruptive selection**
 - D. Selection that removes the

Answer: C

Disruptive selection is at work when both extremes of a range are favoured and the middle is not, so the population splits towards the two ends and the intermediate forms become rare. Given long enough and some barrier to interbreeding, this can be the start of two separate species. Stabilizing selection is the tempting answer because it is the other named pattern most students remember, but it does the opposite: it favours the middle and removes both extremes.

96. In which geologic period does the fossil record show more diverse and relatively higher forms of organism? (1)
- A. Devonian
 - B. ✓ **Cretaceous**
 - C. Jurassic
 - D. Permian

Answer: B

The Cretaceous is the most recent of the four periods listed, running from about 145 to 66 million years ago, while the Devonian, Permian and Jurassic are all older. Life had more time to diversify by then, so Cretaceous rocks hold flowering plants, birds, mammals and the last and most varied dinosaurs. The Jurassic is the tempting answer because it is the period people associate with dinosaurs, but it comes before the Cretaceous, so its fossil record is less diverse.

— END OF MARKING KEY —